PATENT SPECIFICATION

671,935

Date of Application and filing Complete Specification : Feb. 17, 1949.

No. 4369/49.

Application made in Sweden on Feb. 18, 1948.

Complete Specification Published : May 14, 1952.

Index at acceptance :—Classes 2(iii), H ; and 23, A2b.

COMPLETE SPECIFICATION

A Method of Recovering Protein from Protein-containing Material

We, AKTIEBOLAGET SEPARATOR, a Swedish company, of 8 Fleminggatan, Stockholm, Sweden, and IMPERIAL CHEMICAL INDUSTRIES LIMITED, a British company, of Millbank, London, S.W.1, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement :—

This invention relates to a method of recovering protein from protein-containing materials.

Protein for industrial purposes is usually recovered from protein-containing material, such as peanuts and soya beans, in the following way. After peeling the raw material, it is pressed in order to separate the oil and fat and is then treated with a solvent, for instance benzol or benzene, for extraction of the remaining oil and fat. Oil and fat may be extracted from the raw material by means of solvents only, which is a cheaper procedure, but the oil so extracted is of inferior quality. When oil and fat have been extracted, a mass is obtained which consists substantially of fibres and proteins. This is subjected to grinding operations followed by mixing with water containing lye or acid-containing liquid, the acid usually being sulphuric or hydrochloric acid and the lye soda-lye (hereinafter referred to as " chemicals "), so as to obtain such a pH-value that the proteins are wholly or partly dissolved. The liquid thus obtained also contains undissolved substances which are removed by a treatment, generally consisting in a combined filtering or straining and centrifuging operation. These procedures should be carried out in such a way that the loss of protein-containing liquid is as low as possible. The solid substances mainly consist of fibres. Due to the existence of fibres of very small sizes filter cloths, for example textile cloth, which retain all the impurities and produce a clear liquid, cannot be used. For the removal of the solids metal gauze with 80–100 mesh per inch is therefore generally used and part of the fine fibres pass through the strainer and contaminate the strained liquid. Part of the fine fibres, however, stick to the large fibres on the strainer gauze, and can therefore be taken out of the process together with these, as a pulp or paste, which also contains a certain quantity of protein solution. The strained and separated liquid is then subjected to chemical treatment as above described, to regulate the pH-value, and to a mechanical treatment, for example in a suitable disintegrator, to disintegrate particles containing protein, thus causing the protein to be transformed into solid state and making its recovery possible. Solid impurities, mainly, consisting of fibres separated out at the separation treatment of the fibres may be directly withdrawn from the process or subjected to washing or returned to the process for recovering of protein in solution remaining in the said impurities. The method described above has certain inconveniences, for instance, the strainer is often subject to disturbances in its operation, because it is necessary that in addition to the coarse fibres also part of the fine fibres, which often cause clogging of the filter, should be removed by the filter. Another inconvenience is that the fibres are removed from the strainer in a moist state which results in a protein loss corresponding to the amount of moisture. At the reintroduction of protein washed out from the fibres, or of the concentrate of finer fibres removed during the process, there is a risk of increasing the amount of fine fibres in the process.

The present invention relates to a method for the continuous removal of solid substances, such as fibres, from liquid which contains dissolved protein, in which, by coarse-straining, only or mainly such solid impurities (if any), which may clog the nozzles of centrifugal separators used for separation following upon the straining, are removed from the liquid. The strained liquid which contains a considerable part

[*Price 2s. 8d.*]

of the solid impurities is then subjected to preliminary separation in a centrifuge in which the majority of the large particles are continuously separated as sludge concentrate. For this separation, separators which are provided with sludge discharge openings, for instance nozzles located at or near the periphery of the separator bowl and through which the sludge, in spite of its tendency to form in the bowl deposits having a small angle of repose, can be discharged in a highly concentrated state. After this separation the liquid still contains too many fibres which, however, are of small size and very light. The liquid is therefore subjected to a final separation, so-called fine-separation. This is carried out in centrifugal separators of a construction different from the first-mentioned machines. They are provided with sludge discharge channels which have their inlets at the greatest inner diameter of the bowl and their outlets near the centre of the bowl. These separator bowls can be constructed with very steep walls because the sludge which is separated on these has little tendency to deposit on the inside of the bowl wall. Such separators are used particularly in the yeast industry and will therefore for the sake of simplicity be referred to as "yeast separators". Since the content of solid impurities of the liquid to be treated may be comparatively low, and since, for practical reasons, it is undesirable to use nozzles of too small a size, it may be advantageous to return part of the concentrate from the separator either to the inlet of the separator or through separate channels with their outlet openings near the nozzles in the separator bowl. The concentrate obtained at the first separation is mixed with the concentrate from the second separation and then a liquid containing chemicals for obtaining a pH-value at which proteins are more or less dissolved, may be added. The sludge concentrate is then subjected to separation (concentration) in centrifugal separators provided with sludge discharge openings or nozzles for the continuous discharge of the separated sludge. At this separation the throughput is regulated in such a way that the liquid component discharged from the separator is so pure that it can be returned to the process without causing a continuous increase of the content of the solid impurities, i.e. after proceeding for some time the content of solids in the process will remain substantially constant because the separators remove the same amount of solids as is introduced into the process. If no liquid is added to the concentrate from the first and second separation and if the separation is carried out in such a way that the liquid component has the same purity as that obtained in the fine-separation—the second separation—said liquid component can be mixed with the liquid component obtained in the fine-separation. Since, however, it is desired to obtain high concentration of the sludge concentrate it may occur that, due to variation in the running conditions of the separation, the liquid component may acquire an undesirable high fibre content and it may therefore be suitable to mix this liquid component with the liquid intended for fine-separation, although this means that the number of separators for this separation may be increased. If, on the other hand, a liquid is added to the concentrate obtained at the first and second separation prior to the separation of the concentrate, the liquid component obtained at this separation should be returned to the beginning of the process, i.e. where liquid is added for dissolving the protein. The sludge concentrate obtained at the concentrate separation can also be mixed with liquid, if required containing chemicals for obtaining the desired pH-value, and subjected to further separation, at which the throughput is adjusted in the same way as at the first separation and the separated liquid returned to the beginning of the process. The dilution and separation of sludge concentrate and returning of separated liquid to the beginning of the process may be repeated any number of times.

The method according to the invention is illustrated diagrammatically in the accompanying drawing. The raw material from which the main part of oil and fat may have been removed and which substantially consists of protein substances and fibres is fed through a pipe 1 to a mill 2, in which the material is ground. Afterwards or simultaneously liquid is added through, for instance, a pipe 3 to such an extent and of such a pH-value that a pH-value of about 9 is obtained. The suspension is then conducted through a pipe 4 to a strainer 5, on which are removed by coarse straining mainly particles which are larger than the sludge discharge openings in the separators in which the suspension is subsequently separated. The removed coarse particles are, after addition of liquid and chemicals through pipes 7 and 8, respectively, conducted to a second strainer 9. The liquid component from this is returned through a pipe 10 to the pipe 3. Further strainings with addition of liquid to the effluent from the outlet 11 may be effected in any desirable number, the strained liquid each time being returned to the pipe 3. The liquid obtained from the main straining which contains a great part of the original solid substances is conducted through a pipe 12 to a centrifugal separator 13 to be subjected to a preliminary

separation at which the main part of the solid substances in the liquid are separated from the liquid as a concentrate which is discharged through the outlet 14 and is partly returned by way of a pipe 15 to the inlet of the separator or directly to the nozzles in the interior of the bowl. The rest is conducted through a pipe 16 for further treatment. The liquid component from the separator 13 which is conducted through a pipe 17 is subjected to highly efficient separation in a separator 18 which is provided with sludge discharge channels through which the sludge is discharged from the largest diameter of the separator bowl through the said channels to a point nearer the centre of the bowl. The bowls of the separators used for this separation can be constructed with "steeper" walls (smaller cone angle) than is usual for other nozzle separators because the particles are small and light and have therefore no considerable tendency to form deposits with a steep angle of repose on the bowl walls. The sludge concentrate can also at this separation, as shown on the drawing, to a smaller or larger extent be returned through a pipe 20 in the same way as indicated for the separator 13. Considering the generally low solid substance content of the liquid which is conducted to the separator 18 through the pipe 17, it is suitable to return part of the sludge concentrate in the manner described, because the sludge outlets of the separator can be given dimensions that are suitable for practical running. It must, however, be taken into consideration that too much concentrate should not be returned because, if the concentration is carried too far, non-desired deposits may be formed in the separator bowl although the sludge is light. The part of the sludge which is not returned to the inlet or the nozzles of the separator 18 is conducted through a pipe 21 for further treatment. The liquid component obtained at the final separation, in the separator 18, is passed through a pipe 22 for precipitation and recovery of proteins.

For the further treatment of the sludge concentrates obtained at the two separations the concentrates are brought together and water, or other liquid in which protein is dissolved, may be added to them through a pipe 23. The regulation of the desired pH-value for this liquid is effected by addition of chemicals through a pipe 24. The sludge concentrate is then concentrated in a centrifugal separator 25. Because the concentration of the concentrate discharged from the separator 18, as pointed out above, must not be carried too far, it may be suitable to carry out the concentration without previous addition of water or other liquid through the pipe 23. The concentrate separation is thus carried out without dilution of the protein solution and the liquid component discharged from the concentrator separator 25 through the pipe 26 can therefore be returned and mixed with the pure protein solution discharged from the separator 18 through pipe 22 either by bringing them together by conducting the protein solution through a pipe 27 or mixing it with the liquid component fed into the separator 18 by conducting it through a pipe 28 into the pipe 17. The concentration should be carried out in such a way that the highest possible content of solids is obtained of the concentrate leaving the separator 25 through the outlet 30. Due to variations in running conditions it may occur that the liquid component discharged through the outlet 26 may periodically contain too much fibre, and returning this liquid component to the inlet of the separator 18 through the pipe 28 is therefore preferable in spite of the fact that the number of separators 18 or their capacities for the second separation will have to be increased If the concentrates from the separators 13 and 18 through the pipe 23 are diluted with liquid component before the separation in the separator 25, it is most suitable that the liquid component discharged through the outlet 26 is returned through a pipe 29 to the pipe 3 As regards the regulation of the separation of concentrate in the separator 25 the out-separated liquid component should have such a degree of purity that it can be returned without increasing the solids in the process beyond the amount removed therefrom. Part of the sludge concentrate from the concentrator separator 25 can be recirculated, in the same way as indicated for the separators 13 and 18, through the separator, by passing part of it through a pipe 31. The rest of the concentrate can be conducted through a pipe 32 to a separator 35, if desired after addition of liquid and chemicals through the pipes 33 and 34, respectively, for adjusting the pH-value. This separation is carried out in the same way as the before mentioned. Care should however be taken that the liquid component leaving the separator 35 through the outlet 36 is returned to the pipe 3, because this has a lower content of dissolved protein. The concentrate from the separator 35 may be mixed with liquid and re-separated in the system indicated at 37–42. This is only an example and it is evident that this separation process can be indefinitely varied with any desired number of separation stages.

A liquid with a determined pH-value is introduced into the process through the pipe 3 and its quantity must be in direct relation to the amount of press residue, that is the pressed cakes obtained by the pressing of the raw material hereinbefore referred to.

In order to obtain this liquid balance liquid and chemicals in sufficient quantities are fed into the system through pipes 43 and 44.

HAVING NOW particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. A method of recovering substantially pure protein from protein-containing materials, such as peanuts or soya beans, in which said materials, if desired after pretreatment for recovering by-products or removal of undesirable impurities, are suspended in a liquid with a pH-value at which the proteins are more or less dissolved, whereupon the liquid is treated for removal of non-dissolved substances, characterised in that the liquid, after coarse straining, is subjected to a first centrifugal separation at which the main part of the suspended impurities are removed as a concentrate in a centrifugal separator which is constructed for continuous discharge of the concentrate, for example, a nozzle type separator, and that the separated liquid component is then subjected to a second separation in centrifugal separators, which preferably are of the so-called yeast separator type and from which are discharged a purified protein-containing liquid and a concentrate of preferably finer impurities, and that the concentrates from the first and second centrifugal separations are mixed and subjected to a third centrifugal separation in a centrifugal separator with continuous discharge of the solid substances through openings or nozzles in the wall of the separator bowl the throughput and separating ability of which separator is such that the discharged separated liquid component is so pure that it can be returned into the process without causing, in continuous operation, any noticeable increase of the amount of finer impurities in the system or in the purified liquid discharged from the second separation centrifuges.

2. A method according to claim 1, characterised in that before the further separation of the concentrates from the first and second separation said concentrates are mixed with water or other liquid to which chemicals may be added to obtain a pH-value at which the proteins are dissolved.

3. A method according to claim 1 or 2, characterised in that the liquid component from the third separation is brought together with the liquid component from the second separation.

4. A method according to claim 1 or 2, characterised in that the liquid component from the further separation is conducted to the inlet of the separator for the second separation.

5. A method according to claim 1 or 2, characterised in that the liquid component from the further separation is returned into the process and used for dissolving of protein contained in the raw material for protein production, possibly after grinding of the raw material.

6. A method according to any of the preceding claims, characterised in that the concentrate obtained at the third separation is again further separated in one or more stages at such a throughput and separating ability that the purity of the separated liquid component will be so high that it can be returned into the process without causing in continuous operation any noticeable increase of the amount of finer impurities in the process or in the liquid discharged from the second separation, the concentrate before each separation being mixed with water or other liquid, to which chemicals may be added, for obtaining a pH-value at which the proteins are more or less dissolved.

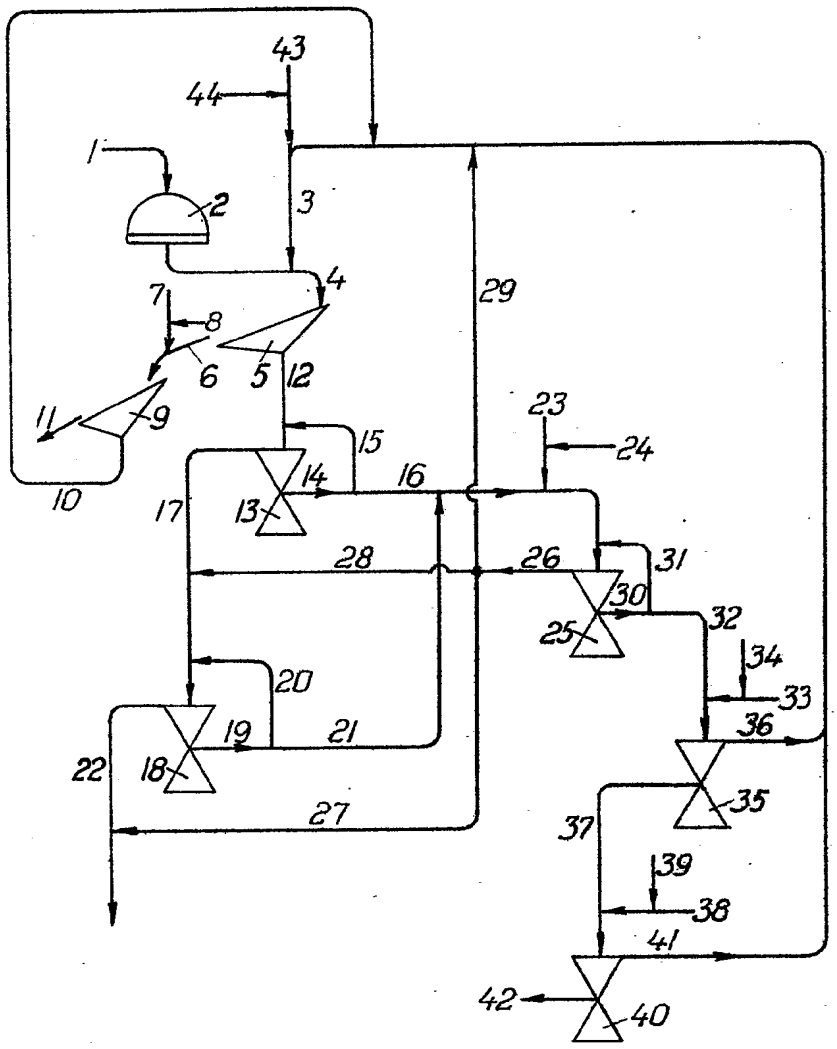
7. A method according to any of the claims 1 to 6, wherein the protein-containing materials are subjected to a grinding operation before being suspended in the liquid for dissolving the proteins and before removal of non-dissolved substances by coarse-straining, characterised in that the coarse solid substances removed at the straining after the grinding are subjected to repeated straining with addition of water or other liquid and that the liquid component obtained at the straining is returned into the process.

8. A method of recovering protein from protein-containing materials substantially as herein described with reference to the accompanying drawings.

Dated this 17th day of February, 1949.

A. A. THORNTON & CO.,
Chartered Patent Agents,
Napier House, 24/27, High Holborn,
London, W.C.1.
For the Applicants.

Redhill: Printed for Her Majesty's Stationery Office, by Love & Malcomson Ltd.—1952.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.



H.M.S.O. (M.F.P.)